Your Seattle City Light

Memorandum

DATE : April 4, 1978

TO : R. E. Mithoug

FROM : W. H. Johnson

SUBJECT : Design Summary
Non-PCB Capacitor Banks
Viewland-Hoffman Substation (W.O. 90730 - PE 7508)
and Canal Substation (W.O. 90719 - PE 7536)

Attached for your informations and comments is a copy of the Design Summary for Non-PCB Capacitor Banks and Viewland-Hoffman and Canal Substations.

WHJ:mb

cc: Mithoug (2)
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525-L (10-76)

VIEWLAND-HOFFMAN SUBSTATION
and CANAL SUBSTATION
Program Elements 7608 & 7536
Work Orders 90730 & 90719
W. H. Johnson
April 4, 1978

DESIGN MEMORANDUM

for

CAPACITOR BANKS

at

VIEWLAND-HOFFMAN SUBSTATION
(Program Element 7508)
(Work Order 90730)

and

CANAL SUBSTATION
(Program Element 7536)
(work Order 90719)

I. SCOPE

This Memorandum describes our coming capacitor bank installation program for Viewland-Hoffman and Canal Substations. The program has been deferred for the last two years in order to allow time for industry development of the new non-PCB (non-Polychlorinated Biphenyls) capacitors. We have completed a study of available capacitor products and will release a Specification by early April, 1978, to purchase capacitor banks for both Viewland-Hoffman and Canal Substations.

II. PROJECT PLAN

A. Viewland-Hoffman Substation

Two 14,400 KVAR capacitor banks will be purchased for installation at Viewland-Hoffman Substation, in the latter part of October 1978. This will be included as part of the Viewland-Hoffman Clean-up work, as the support structures, capacitor switches and conduit are already in place for three capacitor banks.

II. PROJECT PLAN (Cont'd.)

A. Viewland-Hoffman Substation (Cont'd.)

Existing capacitor bank support structures were designed for nine foot long capacitor racks, utilizing 200 KVAR capacitor cans. With the decision to purchase 150 KVAR capacitor cans (see Section IV of this Memornadum) the two new capacitor racks will now be 12 feet long. Civil Engineering is in the process of revising the support structures to accomodate the longer racks. A third capacitor bank will be installed in the future, if additional reactive power is needed.

All capacitor bank relay and control circuits are existing at Viewland-Hoffman Substation. Capacitor banks will be connected in an ungrounded "Y" configuration with two series groups in each leg. Protection of capacitors is accomplished by using a phase unbalance relay which senses voltage between ground and the floating neutral point of the banks. One capacitor out of service produces an alarm and two or more capacitors out trips and locks out the bank via the capacitor switch. Since capacitor banks are tied to the 26 kV bus via a feeder breaker in series with the capacitor switch, an interlock scheme is used to prevent breaker operation on reactive power.

Voltage on the 26 kV bus will be controlled by automatically switching capacitor banks. Capacitor switches will be operated by a time-biased, voltage operated controller.

B. Canal Substation

Along with the Viewland-Hoffman capacitor purchase, two more 14,400 KVAR capacitor banks will be ordered for installation at Canal Substation in 1978. The reasoning for new capacitors at Canal Substation is three-fold.

1. Although the existing capacitor cans at Canal Substation have a low failure rate, the circuit breaker for Capacitor Bank 13-511 has been by-passed due to a failure. This previous failure raises a reliability question on the capacitor breaker for Capacitor Bank 13-512. Since the existing capacitor banks at Canal Substation are coupled to the system via transformer bank tertiary windings, any further capacitor breaker failures could produce a destructive "tertiary fault" on Transformer Bank No. 1. It is, therefore, desireable to remove existing capacitor banks and add new reactive sources to the less vulnerable 26 kV bus.

II. PROJECT PLAN (Cont'd.)

B. Canal Substation (Cont'd.)

2. Capacitor Banks 13-511 and 13-512 are located in an area of the yard needed for part of the new "115 kV Ring Bus Addition" scheduled for 1980 to 1981. It is not feasible to move the existing capacitor banks due to their age, because the foil and dielectric are probably brittle to the point where movement could cause numerous can failures.

3. We will need capacitor banks at Canal Substation during the "115 kV ring bus" construction period.

The 26 kV bus will remain energized dueing construction and will be used to supply reactive power to the surrounding service area. As the fault duty of the 26 kV bus will be greatly reduced without a 115 kV supply at Canal Substation, the amount of reactive power to each line must be kept small to avoid large voltage variations. Therefore, the initial capacitor bank installation will utilize only half of the capacitors on each bank. The remaining capacitors will be disconnected and used as spares for Canal and other substations. During 1981, the spare capacitors will be reconnected in time for the energization of the new 115 kV Ring Bus.

III. NEW STANDARDS AND TESTS FOR NON-PCB CAPACITORS

In order to assure that new capacitors will have a low failure rate, we will ask the manufacturer to provide units which have been constructed to meet all "design" and "routine" tests, per NEMA Standards Publication No. CP1-1976. In addition, alternate bids will be required for two extra "routine" tests, as listed below:

A. Design and Process Proof Test

The first test is a special "Process Proof" test developed by General Electric Company, designed to detect capacitor types which are susceptable to coroma damage. Capacitor designs passing this test should be ible to stand the over voltage conditions present in banks which have lost cans.

III. NEW STANDARDS AND TESTS FOR NON-PCB CAPACITORS (Cont'd.)

B. Loss Determination Test

The second is a "loss determination test", to be performed on all capacitors at 85°C. This test is silimal to Westinghouse's "hot power factor test", and is expected to catch production line imperfections.

Upon bid evaluation, we may ask for one or more of these extra tests, if the price is not prohibitive.

IV. CAPACITOR CAN INTERCHANGEABILITY

Another area covered in our "capacitor study" was capacitor can interchangeability. At the present time, we stock replacement capacitors for substation capacitor banks rnaging from 15 KVAR to 200 KVAR cans. A comparison of the leading manufacturers various capacitor can dimensions shows that 100 KVAR and 150 KVAR capacitor cans are the mose common sizes with interchangeability. A comparison fo cost per KVAR, using the least expensive can (200 KVAR) as a base, shows a 15% price increase for 150 KVAR cans and a 50% prince increase for 100 KVAR cans. With this in mind, the decision has been made to purchase 150 KVAR cans for all new substation capacitor banks.

V. FUTURE CAPACITOR BANK INSTALLATIONS

This purchase will handle the reactive requirements at Viewland-Hoffman and Canal Substations well into the 1980's. The next scheduled capacitor purchase will be for two 14,400 KVAR banks in 1979, to be installed at Creston-Nelson Susbtation.

WHJ:mb

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ROUTING

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